

REMARKS/ARGUMENTS

In response to the Office Action mailed September 15, 2005, finally rejecting the claims, Applicants request reconsideration based upon the following remarks. No claims are added or cancelled and no claims are proposed to be amended.

Although neither of claims 4 or 9 was amended, those claims were objected to as informal. The objection is respectfully traversed.

Claim 4 was allegedly informal as failing to recite the basis of the percentage of hydrogen with respect to the inert gas. In fact, claim 4 expressly recites that it is the volume percentage of hydrogen with respect to the inert gas that is described in terms of percent. Thus, volume percent is present in the claim. It is noted that similar language appears in claims 5 and 6, claims not cited in the claim objection.

Claim 9 was objected to with respect to the subscripts in the formula Si_xN_y . This term is clearly explained in the patent application as filed and is intended to cover the numerous compounds that can be formed between silicon and nitrogen. It is well known in the relevant arts that even these compounds are not always stoichiometric and the term used in claim 9, used without objection in claims 10, 17, and 18, can mean Si_3N_4 , Si_2N_3 , SiN , etc. See the patent application at page 6, line 4. Both objections should be withdrawn.

The invention as described in independent claim 1, the only pending independent claim, relates to a method of manufacturing a semiconductor device. More specifically, the structure relates to the manufacturing of a via hole extending through a series of films and to a conductive layer in a substrate. The conductive layer and the substrate are first covered by a stopper film, on which an interlayer insulating film is then deposited. Then, a capping film is deposited on the interlayer insulating film.

In order to form the via hole, a photoresist film having a particular pattern is formed on the capping film. Then, using the resist film as a mask, the capping film and the interlayer insulating film are etched to form an opening that extends through those two films to the stopper film. The stopper film is not etched because the etchant

employed is stopped by the stopper film, providing the basis for identifying that film as a stopper film.

In the final steps of the claimed process, the resist film is left in place after etching the capping film and the interlayer insulating film, and a different etchant is employed to etch the exposed part of the stopper film to complete the via hole. Only after that step is the resist film removed in an ashing process.

The only rejection of claim 1 appearing in the Office Action mailed September 15, 2005 is a rejection for obviousness over Wang et al. (U.S. Patent 6,124,201, hereinafter Wang) in view of Savas et al. (U.S. Patent 6,805,139, hereinafter Savas). This rejection is respectfully traversed.

Many, but not all, of the dependent claims were rejected on the same basis on which claim 1 was rejected. In addition, the other dependent claims, claims 4-6 and 12-14, were rejected as unpatentable over Wang in view of Savas and further in view of an abstract from the IBM Technical Disclosure Bulletin. From the form of these rejections and the fact that claim 1 is the only independent claim, it is apparent that if claim 1 is not obvious over Wang in view of Savas, then that claim must be allowed and so must all of the dependent claims 2-19.

In applying Wang, the Examiner directed attention to the process described in claim 1 of Wang, a process Wang refers to as prior art and which is not clarified by any drawing. In that process, a “thin stop nitride” layer is first deposited and the Examiner properly compared that film to the stopper film of claim 1. Then, in Wang, a separating oxide layer is deposited which was compared, properly, to the interlayer insulating film of claim 1. In Wang, the third deposited film is a “thin via nitride” which the Examiner, again properly, compared to the capping film of claim 1.

Although described only in an inverted way, Wang applies a pattern of a photoresist for the etching of the “via nitride”. This step corresponds to etching of the capping film in the invention but not to the etching of the interlayer insulating film according to claim 1. In the claimed process, that same resist film is used for etching both the capping film and the interlayer insulating film in order to form an opening that reaches the stopper film. To meet this step Wang would have to describe etching both the

“via nitride” and the “separating oxide layer” to expose the “thin stop nitride” with the resist film in place. However, that process is not what is described by Wang.

Rather, in Wang, according to the passage at column 1, lines 53-62, only the “via nitride” is initially etched. Then, before etching the separating oxide layer, the photoresist is removed, quite contrary to the claimed invention where the resist remains in place. In Wang, after depositing a second oxide layer and forming another photoresist mask, some magic etching process occurs that etches through the second oxide film, and apparently through the separating oxide film, to reach the “thin stop nitride” layer. Thereafter, that second photoresist mask is removed and, finally, the “thin stop nitride” layer is etched to complete formation of the via hole.

As already pointed out, in the invention, the original resist film is left in place even after the etching of the interlayer insulating film and is used in etching the stopper film to complete the formation of the via hole. As described in the patent application, particularly with respect to Figure 7C, if the resist film is removed early, then the via hole becomes undesirably enlarged in area and tapered in cross-sectional shape. This result occurs because the etchant etching the stopper film etches not only the stopper film but also the exposed part of the capping film, from which the resist has been removed, and the interlayer insulating film. The tapering is avoided in the invention by leaving the resist film in place until after the stopper layer has been etched. In other words, the continued presence of the resist film is not merely accidental or unrelated to the result that is achieved. The presence of the resist film is important to control the shape of the via hole. There is no such mask present in etching the “thin stop nitride” in Wang.

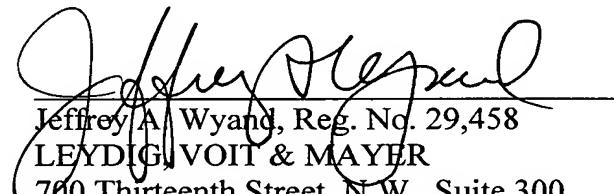
In the final step of claim 1, the photoresist is removed by ashing in a mixture of hydrogen and an inert gas that does not react with hydrogen. For that step, and only for that step, reliance was placed upon Savas. Applicants agree that Savas describes the stripping of photoresist by ashing using a mixture of hydrogen and an inert gas that does not react with hydrogen.

In order to demonstrate *prima facie* obviousness of a claim, it is critical that all of the elements of the claim be shown to be present in the prior art. If all of the elements of the claim are present in the prior art, then it is also critical to demonstrate that one of skill

in the art would combine the elements as in the claimed invention in order to show that the invention is obvious and not patentable. Here, the first of these two essential requirements is missing so that the second requirement cannot even be considered. Wang, like the prior art described in the patent application, removes the photoresist before the etching of the stopper layer, i.e., the thin stop nitride layer. In fact, in Wang, two photoresist masks are separately employed in forming the via hole and each of those masks is removed before the etching of the thin stop nitride layer. Therefore, the portion of Wang cited in the rejection does not contain the disclosure required to establish, in combination with Savas, *prima facie* obviousness of claims 1 and of claims 2-19.

Because the rejection of claim 1 is deficient, Applicants respectfully request reconsideration and allowance of that claim 1 and all of claims 2-19, since those claims all depend directly or indirectly from claim 1.

Respectfully submitted,



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